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Title: Being Innovative: Katie Mussack Using teamwork to solve difficult national security challenges

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Being Innovative: Katie Mussack

Lab Character: Who We Are



Katie Mussack

**Using teamwork to solve
difficult national security
challenges**

From a young age, Katie Mussack has delighted in problem solving, critical thinking and discovery. “Playing with math was just part of our family culture,” she says. Her parents were both math teachers, and her engineer grandfather introduced her to science.

As a physicist with the XTD Integrated Design & Assessment group (XTD-IDA), she is following those passions to new heights.

Every year, there is one monolithic milestone that carries more weight than all the rest. Simply called “level 1 milestone,” it is an annual nuclear weapons challenge. Katie was chosen to co-lead this year’s L1 milestone team.

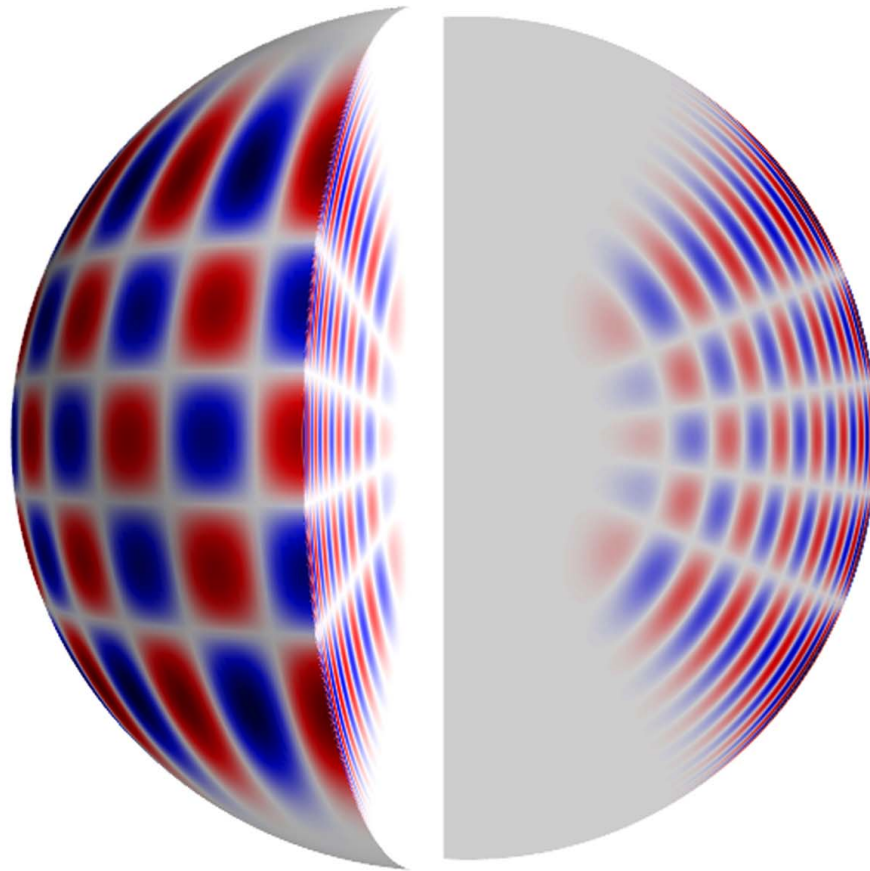
Each challenge is tasked to the rival-sister Labs of Los Alamos and Lawrence Livermore to solve jointly. The outcome strengthens national security and heavily impacts the grade each Lab receives from the U.S. Department of Energy.

The details are classified, but Katie and co-lead **Heather Whitley** of Lawrence Livermore National Laboratory are guiding this team to find the best ways to assess and advance our ability to predict nuclear performance. The joint LANL-LLNL work has a core team of 10, but there are many others contributing to the effort and working on a LANL-specific portion of the milestone.

Not only is Katie fairly early in her career to be given this weighty leadership responsibility (most have a decade more experience), but she’s doing so with a collaborative outlook, says her group leader, **Leslie Sherrill**. “She gets everyone on the same train going in the same direction.”

Unexpected journey beyond the sun: from solar core to subs

Katie hopped on this train quite unexpectedly. Her doctoral work was focused on the physics of the solar core, and she took postdoc positions at the Institute of Astronomy at the University of Cambridge and at LANL because of her interest in using helioseismology (pictured) to probe the solar interior.



Katie had met astrophysicist **Joyce Guzik** (a Lab Fellow in XTD) at conferences, and the opportunity to work with her was Katie's main reason for coming to Los Alamos in 2009. She planned to spend two years as a postdoc at LANL and then launch her career somewhere else. But once she was exposed to the classified work that goes on "behind the fence" at LANL, she was drawn to a community of experts working together on a wealth of complex problems.

"As an astrophysicist, all of my work was purely theoretical, trying to understand the inner workings of distant objects without ever being able to interact with them. No experiments. No intervention. No design," Katie says.

"Here, I answer real-world questions, design experiments and help generate products that actually make a difference in our lives," she continued. "I play a role in maintaining national security. The more I learn about the history and politics surrounding nuclear weapons, the more I realize that what we do here matters."

Breakthrough thinking: "My idea of fun!"

The Lab has an extra helping of innovative thinkers, which creates an inviting space for breakthrough thinkers like Katie. "X Division is the perfect place to exercise creativity, agility and resourcefulness on

a daily basis — that's my idea of fun,” she says.

What makes her stand out, though, is being an excellent scientist who collaborates well with others and checks her ego at the door, according to her group leader, Leslie.

Leslie interviewed Katie originally for a postdoc position. The two met up again this year when Leslie moved to the XTD Integrated Design & Assessment group to become group leader, and Katie stepped up to become the acting deputy group leader to facilitate the transition.

Not prone to quick decisions or quick judgments, Katie looks at all the facts and listens to all the people. “Katie is working with an excellent team, and she is not afraid to listen to everyone’s opinions and come up with a path forward,” Leslie elaborates. “People respect her leadership and appreciate her collaborative process.”

To be innovative in the present, Katie must be well versed in the past. She has been mentored by Lab Fellows **Joyce Guzik**, **Fred Mortensen**, **John Pedicini** and **Bernie Wilde**, who designed and tested our nuclear stockpile systems. “Learning from them has been a highlight of my career,” Katie says.

That knowledge base has been essential as she has worked for the past five years on the W88 Alternation (Alt) 370 program, which is updating a nuclear warhead that entered the stockpile in 1988. The W88 is deployed on the Navy’s Trident II D5 Submarine-Launched Ballistic Missile on Ohio-class ballistic missile submarines.

Katie works closely with **Donald Sandoval** (XTD Primary Physics, XTD-PRI). “Don and I are working with an incredible team of the top scientists and engineers to modernize the W88. It is a fast-paced, detail-oriented program full of challenges and successes,” Katie says.



Credit: U.S. Strategic Command

Case study in 'thought experiments'

Prior to co-leading this year's L1 milestone, Katie was part of an innovative team that was steered behind the scenes with guidance and encouragement from celebrated weapons designer John Pedicini.

In 2018, the Navy had a classified question about nuclear weapons and it turned to Los Alamos for an answer. "To answer the question, we started brainstorming," says Katie, who partnered with colleagues **Omar Wooten** and **Guillermo Terrones** on what she calls "thought experiments."

"We started by talking about the physics at play and how we wanted to change the dynamics of the system in the question," she explains. The trio discussed and went back and forth on new ideas. Then they independently investigated different parts of the problem before continuing their conversation. Eventually, they began doing computer simulations, with actual experiments to come later.

"Our initial goal was to show the Navy that we could be responsive when asked a question," Katie says. "Then we came up with ideas that could actually work."

Katie took lessons from John Pedicini to heart. "He pushed us, but he did it out of love: love for us, the science, the product, the nation," Katie says. "His encouragement gave us the freedom to explore and

trust ourselves while also questioning ourselves. We needed to think deeply about what we were doing.”

They also needed to talk about what they were doing — to bounce ideas off colleagues not directly involved in the problem. “The Lab is not just a collaborative environment. It’s a collaborative environment full of experts,” Katie says. “Everyone’s door is open, and people are excited to talk about their work and thoughts.”

Katie is quick to point out that her team’s ability to answer a challenging question builds on not only this collaborative environment but also on decades of previous Laboratory research. “I looked back through historical documents and saw ideas that were similar to the ideas we were brainstorming,” she says. “I was able to use some of those ideas and develop them further to finally answer the Navy’s question.”

“Innovation is slow steady progress that builds to one thing that people notice,” she continues, noting that progress is often the result of failure. “You come up with an idea, try it, and if it doesn’t work, try something else.”



Editor's Note: This story was adapted from an article in the Lab's National Security Science magazine.

Know someone who embodies a Lab character trait and deserves some recognition? Send nominations to dianadel@lanl.gov.



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